Low-Noise Cage Type
Double-Seated Control Valve
Model : VDN
User's Manual

Azbil Corporation
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LOW-NOISE CONTROL VALVE
MODEL: VDN

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1. GENERAL

A. Nameplate

All necessary items concerning valve construction and operation are listed in the nameplate. Before installing, make sure that SPRING RANGE, PACKING and LUBRICANT conform with the instructions on the nameplate.

![Figure 1. Nameplate](image)

B. Valve Installation

Before installing valve, remove scales and metal chips inside process piping, then follow the procedures below.

1. Set the marking (IN, OUT) on the connecting flanges of valve body in direction of flow.

2. Tighten bolts of connecting flanges evenly and firmly making sure that no excess stress is given to the valve body.

3. Connect air piping to controller using 1/4" PT mail fitting.

C. Gland Packing Lubrication (when asbestos packing used)

Note: Be sure to use proper lubricant. Check the lubricant No. against the nameplate. The packing such as Teflon packing, requiring no lubricant, are not indicated on the nameplate.
D. Lubricator Installation

If it becomes necessary to feed lubricant to valve, stop valve operation and release pressure inside piping. Then, remove blind plug of bonnet and mount lubricator to the bonnet.

(1) Before operation

Lubricator is filled with lubricant. Loosen lubricator handle and turn in press screw to feed lubricant. If lubricant cannot be fully applied to packing when press screw is fully turned in, close lubricator handle, remove press screw and insert new lubricant. Then loosen lubricator handle and screw in the press screw. Repeat it until the lubricant fully applied to packing. Next, tighten packing flange nuts, re-screw-in the pressure screw and close lubricator handle.

(2) Lubrication during operation

When lubricator is to be filled with lubricant during operation, make sure to fully tighten lubricator handle. To feed lubricant in the gland, remove press screw and insert lubricant. Then, turn in press screw while loosening lubricator handle. Repeat it until the lubricant fully applied to packing. Close lubricator handle. If the flow in process piping can be shut off, follow the procedure described in paragraph 1) “Before Operation”.

2. CHECKOUT FOR VALVES IN SERVICE

Prior to starting valve operation, inspect following to prevent possible troubles during operation. If the flowing medium is leaking from valve, check the points of 7), 8), 10), 11) and 12).

(1) All air connectings tight?
(2) Diaphragm case bolts tight?
(3) Diaphragm spring compression properly adjusted?
(4) Both actuator and valve stems connected firmly?
(5) Stems properly adjusted?
(6) Actuator stem and valve stem straight and aligned?
(7) Both stems scored, nicked and scratched?
(8) Packing flange nut finger tight?
(9) Actuator yoke lock nut tight?
(10) For valve with asbestos packing and lubricator, packings properly lubricated?
(11) All body nuts tight?
(12) Valve is installed on a straight line with process piping?

3. OTHERS

For handling of valve with belows seal, refer to section “Disassembly and Reassembly of Valve with Bellows Seal”.

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4. CONSTRUCTION OF VALVE BODY

The valve body assembly consists of a valve body and a bonnet which are fixed together with stud bolts and nuts. The valve body has a valve plug, seat ring(s), cage, etc.

The VDN Type (Low Noise Type) Control Valve is in the construction that a low-noise type trim has been incorporated on the base of VDC type (cage type, double seat) control valve. Therefore, the VDN Type Control Valve has functions the same with those of the VDC type valve plus the low-noise feature.

Conversion from Type VDC to Type VDN (or from Type VDN to Type VDC) can be made simply the changing the trims, since other components are identical.

External dimensions (installation dimensions, dimensions between faces of the valve body), disassembly and assembly procedures and adjustment methods of the VDN valves are the same with those of the VDC valves.

When the control valve has an extension type bonnet, the valve can be handled as a common type valve.

![Diagram of valve body assembly](image)

**Figure 3.**

<table>
<thead>
<tr>
<th>Model change</th>
<th>Parts required for change</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDC</td>
<td>Cage*</td>
</tr>
<tr>
<td>VDN</td>
<td>Valve plug (with stem)*</td>
</tr>
<tr>
<td>(low-noise type)</td>
<td>Gasket (top)........... common parts</td>
</tr>
<tr>
<td></td>
<td>Gasket (bottom)........... common parts</td>
</tr>
<tr>
<td></td>
<td>Spiral gasket........... common parts</td>
</tr>
</tbody>
</table>

* Model alteration cannot be made only by replacing the cage or valve plug. It is necessary to replace as the trim set.
5. ADJUSTMENT

A. General

As a rule, diaphragm control valve requires no adjustment. However, adjustment should be made after overhaul or changed in specifications or parts replacement. For disassembly or re-assembly of valve or parts replacement, refer to paragraphs on latter pages.

B. Stem And Spring Adjustment

Caution: In case of bellows seal type, do not turn valve stem.

a. Direct acting

Loosen stem connector so that the valve stem can be turned smoothly. Screw in valve stem securely to stem connector. Connect air line and set air pressure to maximum value of spring range. Unscrew valve stem until valve plug just seats. If the stem connector has not been set as yet, push down valve stem and seat valve plug to seat ring, then set air pressure to maximum value of spring range and set stem connector. Loosen travel indicator scale captive screws. Align “shut” on scale with pointer. Then, tighten stem connector firmly.

b. Reverse acting

Connect air line and set air pressure to a little higher than minimum value of spring range. Loosen stem connector so that the valve stem can be turned smoothly. Screw the valve stem fully into the stem connector. Set air pressure to minimum value of spring range. Unscrew valve stem until valve plug just seats. If the stem connector has not been set as yet, push down valve stem and seat valve plug to seat ring. Set stem connector. Loosen travel indicator scale captive screws. Align “shut” on the scale with pointer. Then, tighten stem connector firmly.

Figure 4. Model VA1R, VA2R diaphragm motor actuator, (Revers acting type)

Figure 5. Model VA4 and VA5 diaphragm motor actuator, (Direct acting type)
6. DISASSEMBLY AND REASSEMBLY

A. Disassembly

Caution: Before disassembling, be sure to stop the flow in process piping.

a. Apply air pressure to diaphragm and hold so that the pointer indicates a little above fully closed position.

b. Loosen stem connector and separate actuator stem from valve stem.

c. Remove air line.

d. Unscrew yoke lock nut to remove actuator from valve body.

e. Loosen packing nut, remove nuts for bonnet. Remove bonnet with precaution measure for not damaging the gland packing.

f. Remove the valve plug, gasket (top), cage, gasket (bottom), and spiral gasket in the due order from the valve body. (The split cage valve has no spiral gasket.)

The cage can be removed by pulling straight upward since it is not screw fixed; it straightly (* The split-type cage is screw fixed.)

B. Reassembly

To reassemble the valve, follow the above procedures but in reverse order by following precautions measure.

Caution: (1) Use a new spiral gasket. Gasket (lower) has a function to set up the shrinkage allowance of spiral gasket besides the function of sealing, use only gasket supplied by Yamatake Corporation.

(2) To tighten nuts for bonnet, first fix all nuts lightly with hand and then tighten them evenly with a spanner.

(3) When mounting steam connector, be sure that meshed length of threaded section of both stems are identical.

(4) For replacement of the new valve plug, screw-in the valve stem then drill a hole in guidance to the pre-drilled hole on the plug and completed with 1/50" taper reaming. Then insert the taper pin.
7. PARTS REPLACEMENT

A. Diaphragm Replacement

a. Direct acting actuator

(1) In case of VA1, VA2 and VA3 actuators, first remove air line, then loosen spring by turning spring adjuster to the right. After removing of diaphragm case (upper), pull out split pin and remove slotted nut. When removing slotted nut, hold pointer lock nut with a wrench to hold stem, if necessary. Remove stopper and replace diaphragm. After reassembling, readjust spring compression.

(2) In case of model VA4 and VA5 actuators, first remove air line, then loosen spring adjuster and remove diaphragm case (upper) and stopper. Replace diaphragm. After reassembling, readjust spring compression.

b. Reverse acting actuator

(1) In case of model VA1R, VA2R and VA3R actuator, first remove air line. Then loosen spring adjuster and remove diaphragm case (upper). Pull out split pin and remove slotted nut. When removing slotted nut, hold pointer lock nut with a wrench to hold stem, if necessary. Remove stopper and diaphragm plate. Replace diaphragm. After reassembling, readjust spring compression.

(2) In case of model VA4R and VA5R actuator, first remove air line. Loosen spring adjuster and remove diaphragm case (upper). (If diaphragm is to be replaced with actuator left on valve body, it is unnecessary to loosen spring adjuster.) Loosen nut for diaphragm plate hold diaphragm to actuator stem. Replace diaphragm. After reassembling, apply a sufficient amount of adhesive agent to nut of diaphragm plate to prevent air leakage. Readjust spring compression.

B. "O" Ring Replacement (Reverse acting actuator only)

a. Model VA1R, VA2R and VA3R actuator

First apply air pressure slightly higher than lower limit of spring range to diaphragm and remove stem connector. Turn spring adjuster to the right to loosen spring. Remove diaphragm case (upper) and remove pointer lock nut and pointer by turning pointer to the left. Left out diaphragm, diaphragm plate and actuator stem. Remove "O" ring using a marking needle or like. Replace "O" ring. When replacing, slot in which "O" ring is fitted should be cleaned and coated with a little amount of silicon grease. After reassembling, readjust spring compression.

b. VA4R and VA5R actuator

Remove diaphragm case (upper) without applying air pressure. Remove slotted nut on the diaphragm plate and take out diaphragm plate, diaphragm and washer. Turn nut of bellows assembly and pull out bellows assembly. Remove "O" ring from inside of groove in the bottom of bellows assembly. Replace "O" ring.
Figure 6. Model VA1D, VA2D and VA3D, direct acting actuator, cross section.

Figure 7. Model VA1R, VA2R and VA3R, reverse acting actuator, cross section.
Figure 8. Model VA4D and VA5D, direct acting actuator, cross section.

Figure 9. Model VA4R and VA5R, reverse acting actuator, cross section.
C. Packing Replacement

Caution: Before replacing packing, stop flow and make sure that no pressure is remaining inside of valve.

a. Asbestos packing replacement

First, loosen packing flange nuts, life out packing flange and packing follower and take out packings with a packing hook. Next, insert new packings in proper order, cut section of each packings should be positioned 90° to 180° away from another and press them with packing follower. Secure packing flange nuts tightly.

b. "V" PTFE packing replacement

Separate actuator and valve stems and loosen yoke lock nut. Remove actuator from valve body, loosen packing flange nuts and remove packing follower from valve stem. Take out old packings with a packing hook, insert new packings and press with the packing follower. After reassembling, tighten packing flange nuts and realign the connection of stems.

Figure 10. Asbestos packing.  
Figure 11. "V" PTFE packing.  
Figure 12. Asbestos and "V" PTFE, combined packing.
D. Trim Replacement

a. Trim replacement of Model VDC and VAC control valve

For replacement, refer to the section “Disassembly and Reassembly”. Replace valve plug and valve stem as an assembly. If either one of them is to be replaced, remove welded part of valve plug using a drill or other tool. Unscrew and separate valve stem from valve plug. Screw valve stem into new valve plug and weld thoroughly around the screw end, then check the linearity of valve stem. For welding, select welding rod conforming to the trim material. Refer to the table below.

<table>
<thead>
<tr>
<th>Material of Trim</th>
<th>Welding Rod</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCS24 (17-4PH)</td>
<td>JIS D-308</td>
</tr>
<tr>
<td>SCS13</td>
<td>JIS D-316</td>
</tr>
<tr>
<td>SCS14</td>
<td>JIS D-316</td>
</tr>
</tbody>
</table>

If trim is of a special material, use a cognated welding rod.

To replace cage, first install spiral gasket and gasket (lower) to body before installing cage and then place gasket (upper). If cage and plug are to be replaced as the set, perform lapping operation in prior to the assembly.

For the valve with a lubricator, fill lubricator with lubricant referring to item d of “General” section.

* The split cage is not provided with spiral gasket.

b. Trim replacement of Model VST, VAV and VAA control valve

For replacement of trim, follow the procedures in “Disassembly and Reassembly” section but in reverse order. Fitting should be performed with valve plug, valve stem, gasket (lower) and guide ring assembled to valve body.

c. Replacement of VDN trim:

The valve stem is connected to the valve plug in a “pin drive” system. For trim replacement, refer to Subsection 2 “REASSEMBLY” of Section “DISASSEMBLY AND REASSEMBLY.”
8. ACTION CHANGE OF ACTUATOR

A. General

Valves with model VA1, VA2 and VA3 actuator, action of actuator revolved in reverse actuation. To change the actuation, prepare necessary parts and follow the procedures described in this paragraph.

Parts to be used for action change from direct to reverse acting

<table>
<thead>
<tr>
<th>Model No.</th>
<th>VA1D</th>
<th>VA2D</th>
<th>VA3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts</td>
<td>Lift (mm)</td>
<td>Part No.</td>
<td>Q'ty</td>
</tr>
<tr>
<td>Adapter</td>
<td>-</td>
<td>80224016-001</td>
<td>1</td>
</tr>
<tr>
<td>Guide bushing</td>
<td>-</td>
<td>80224012-001</td>
<td>1</td>
</tr>
<tr>
<td>&quot;O&quot; ring</td>
<td>-</td>
<td>80256902-003</td>
<td>1</td>
</tr>
<tr>
<td>Hex-head bolt</td>
<td>-</td>
<td>80592042-004</td>
<td>6</td>
</tr>
<tr>
<td>Gasket (A)</td>
<td>-</td>
<td>80224017-001</td>
<td>2</td>
</tr>
<tr>
<td>Gasket (B)</td>
<td>-</td>
<td>80225046-001</td>
<td>6</td>
</tr>
<tr>
<td>Truss screw</td>
<td>8 10 14.3</td>
<td>80592152-001</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>19.05 25</td>
<td>Not required</td>
<td>-</td>
</tr>
</tbody>
</table>

| Lift adjuster | 14.3 | 80225043-001 | 1 | 14.3 16 | 80225043-005 | 1 | 14.3 16 | 80225043-003 | 2 |
|               | 19.05 25 | Not required | - | 19.05 20 | 80225043-004 | 1 | 19.05 20 | 8025043-006 | 1 |
|               | 23.8 25 | 80225043-001 | 1 | 23.8 25 | 80225043-002 | 2 |
|               | 31.75 37.5 | Not required | - | 31.75 | 80225043-003 | 1 |

- 11 -
Parts to be used for action change from reverse to direct acting

<table>
<thead>
<tr>
<th>Model No.</th>
<th>VA1D</th>
<th>VA2D</th>
<th>VA3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lift (mm)</td>
<td>Part No.</td>
<td>Q'ty</td>
<td>Lift (mm)</td>
</tr>
<tr>
<td>Parts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hex-head bolt</td>
<td>14.3</td>
<td>80592042-001</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
<td>16</td>
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<tr>
<td></td>
<td>20</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>19.05</td>
<td>80592042-001</td>
<td>4</td>
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<td></td>
<td>23.8</td>
<td>80592042-008</td>
<td>4</td>
</tr>
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<td>25</td>
<td></td>
<td>25</td>
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<tr>
<td></td>
<td>31.75</td>
<td>80592042-001</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>17.5</td>
<td>80592042-004</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lift adjuster</td>
<td>14.3</td>
<td>Not required</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td></td>
<td>16</td>
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<td></td>
<td>20</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>19.05</td>
<td>80225042-003</td>
<td>4</td>
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<td></td>
<td>23.8</td>
<td>80225042-002</td>
<td>4</td>
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<tr>
<td></td>
<td>25</td>
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<td>25</td>
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<td></td>
<td>31.75</td>
<td>80225042-001</td>
<td>4</td>
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<td></td>
<td>37.5</td>
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<td>37.5</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>17.5</td>
<td>80225042-003</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>B. Procedures For Change (refer to Figures in &quot;Parts Replacement&quot; section)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Remove air line.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) Turn spring adjuster in clockwise, until spring compression becomes zero.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) Remove stem connector, loosen lock nut. Remove pointer which is screwed in.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Remove bolts of diaphragm case and remove upper diaphragm case.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Lift out diaphragm together with actuator stem.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
a. To change from direct acting to reverse acting

(1) Pull off spring, remove bolts and remove lower diaphragm case. Next, lift out spring adjuster and spring retainer, and remove spring retainer.

(2) Proceed to assembly for reverse acting actuator by referring to illustration. Install spring adjuster and screw in spring retainer, then install spring.

(3) Place diaphragm case (lower), guide bush, adapter with “O” ring, and gaskets (A and B), on designated positions by referring to illustration and tighten them with bolts listed on Table 1.

(4) Install lift adjuster to actuator stem. Tighten truss screw making sure that lift adjuster is correctly in contact with captive plate. Then, insert actuator stem (diaphragm is assembled).

(5) Place upper diaphragm case and tighten bolts. Be sure that the bolts are tightened evenly.

(6) Screw pointer to actuator stem and lock it with pointer lock nut. Install stem connector.

(7) Connect air line.

(8) Adjust spring compression by referring to “Adjustment” section.

b. To change from reverse acting to direct acting

(1) Remove bolts and remove adaptor and diaphragm case (lower). Turn spring adjuster clockwise and remove it. Lift out spring and spring retainer.

(2) Proceed to assembly for direct action referring to the illustration; place spring adjuster and then screw it in spring retainer. Install spring.

(3) Place diaphragm case (lower) and lift adjuster and tighten them with bolts listed on Table 2. As shown in the illustration, lift adjusters are on the same position as bolt holes. In model VA2 actuator, a total of 4 lift adjusters should be arranged on every other hole, and in model VA3 actuator a total of 3 adjusters on every third hole. Long and short lift adjusters are sometimes piled up one upon another depending on the lift. If bolts are not the same in length, use longer ones for fixing lift adjusters.

(4) Insert actuator stem (diaphragm is assembled).

(5) Place upper diaphragm case and tighten bolts. Be sure that bolts are secured evenly.

(6) Screw pointer to actuator stem, and lock with pointer lock nut. Install stem connector.

(7) Connect air line.

(8) Adjust spring compression by referring to “Adjustment” section.
9. DISASSEMBLY AND REASSEMBLY OF VALVE WITH BELLOWS SEAL BONNET

A. Disassembly

a. Follow the procedures in “Disassembly” in item a~e under “Disassembly and Reassembly” section of valve which has conventional type bonnet.

b. Remove gasket (upper) for bellows flange.

c. Remove hex-nut for bellows flange. When loosening nut, hold bellows seat with a spanner so that no undue force is given to bellows.

d. Remove bellows flange and gasket (lower). To remove, knock bellows seat lightly.

e. Remove nut for extension bonnet. Remove extension bonnet.

f. Remove stem and plug. The stem and plug are combined with bellows, bellows seat and pin.

g. Disassemble by following “Disassembly” in item f and item g under “Disassembly and Reassembly” section.

B. Reassembly

For reassembly, follow the above procedures but in reverse order. When tightening hex-nut for bellows flange, be careful not to allow undue force to bellows.

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**Figure 15.** Cross section of bellows seal bonnet.
<table>
<thead>
<tr>
<th><strong>Document Number:</strong></th>
<th>OM2-8110-1300 (FC-8805)</th>
</tr>
</thead>
</table>
| **Document Name:**  | Low-Noise Cage Type Double-Seated Control Valve  
| **Date:**           | 1st edition: Nov. 1998  
| **Issued/Edited by:** | Azbil Corporation |
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